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Sentinel-1 SAR for wind energy roughness maps over land

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For the wind energy application, updated information on aerodynamic surface roughness is important for an accurate prediction of the land surface effect on the atmosphere. Tall wind turbines are commonly sited in forested areas, and since the forest both increase turbulence levels and decrease the wind resource, the parametrization of forest roughness in wind models is of high relevance. Here, we investigate whether the Sentinel-1 SAR images can be used to identify high-roughness forested areas. The backscatter properties of the SAR images are compared to digital surface models and vegetation density maps derived from near-concurrent aerial lidar scans (ALS). These ALS products have previously shown good results in wind models for the wind energy application, but the scans are costly to perform and therefore typically only represent a snapshot in time, whereas the Sentinel mission SAR images provide frequent updated information. We investigate how the SAR images vary with season over both deciduous and needle-leaf forests and in addition test whether nearby meteorological observations can explain image to image differences in the backscatter level. In order to understand the backscatter level, new products from the ALS point cloud are derived and compared with the SAR images. This part of the work is focused on whether we also can quantify the roughness based on the SAR backscatter. Since SAR images are affected by speckle noise, they are averaged over monthly and bimonthly intervals after careful inspection of each image. The work is focused on the Østerild test site for large wind turbines in Northern Denmark, where extensive wind experiments have been performed.